Topics

› AUTOSAR Introduction

› Approaches and standards

› Developing the Adaptive Platform

› Achievements, plans, organization
Topics

› AUTOSAR Introduction

› Approaches and standards

› Developing the Adaptive Platform

› Achievements, plans, organization
AUTOSAR Vision

AUTOSAR aims to improve complexity management of integrated E/E architectures through increased reuse and exchangeability of SW modules between OEMs and suppliers.

**Exchangeability between suppliers’ solutions**

- **Supplier A**
  - Chassis
  - Safety
  - Body/Comfort

- **Supplier B**
  - Chassis
  - Safety
  - Telematics

- **Supplier C**
  - Body/Comfort
  - Powertrain
  - Telematics

**Exchangeability between manufacturers’ applications**

- **Platform a.1, a.2, a.n**
- **Platform f.1, f.2, f.n**

**Exchangeability between vehicle platforms**

- **Platform b.1, b.2, b.n**
- **Platform c.1, c.2, c.n**
- **Platform e.1, e.2, e.n**
- **Platform d.1, d.2, d.n**
Aims and benefits of using AUTOSAR

AUTOSAR aims to standardize the software architecture of Electronic Control Units (ECUs). AUTOSAR paves the way for innovative electronic systems that further improve performance, safety and environmental friendliness.

- Hardware and software – widely independent of each other.
- Development can be decoupled by horizontal layers, reducing development time and costs.
- Reuse of software enhances quality and efficiency.
Exploitation of the standard provides significant benefits

- Establish development distribution among suppliers
- Compete on innovative functions with increased design flexibility
- Simplify software and system integration
- Reduce overall software development costs

An industry standard is established.

OEM
Supplier
Tool provider
New market entrant
Exploitation of the standard provides significant benefits

- Enable more efficient variant handling
- Reuse software modules across OEMs
- Increase efficiency of application development
- Invent new business models

An industry standard is established.
Exploitation of the standard provides significant benefits

- Interface with development processes
- Embed tools into an overall tool environment
Exploitation of the standard provides significant benefits

An industry standard is established.

- Enable new business models by means of standardized interfaces
- Easily understand how automotive software is developed
Cooperation partner structure

A three tier structure, proven in similar initiatives, is implemented for the development cooperation. Appropriate rights and duties are allocated to the various tiers.
Cooperation partner structure

- Organizational control
- Administrative control
- Technical contributions
- Definition of external information (web-release, clearance, etc.)
- Leadership of Working Groups
- Involvement in Working Groups
- Exploitation of the AUTOSAR standard
Cooperation partner structure

- Design and use the AUTOSAR standard
  - Leadership of working groups
  - Cooperation in working groups
  - Royalty free exploitation license

**GENERAL OEM**

**GENERIC TIER 1**

**STANDARD SOFTWARE**

**TOOLS AND SERVICES**

**SEMI-CONDUCTORS**
Cooperation partner structure

An opportunity for small companies and start-ups

- Dedicated expertise contributions
- Cooperation in working groups
- Royalty free exploitation license
Cooperation partner structure

ASSOCIATE PARTNERS

Make use of the AUTOSAR standard
• Royalty free exploitation license

ATTENDEES

Participation for research, educational, and similar institutions
• Dedicated expertise contributions
• Cooperation in working groups
## Top-level goals of AUTOSAR – 9 Project Objectives

<table>
<thead>
<tr>
<th>PO 1</th>
<th>PO 4</th>
<th>PO 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transferability of software</td>
<td>Definition of an open architecture for automotive software</td>
<td>Collaboration between various partners</td>
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<tr>
<td>PO 2</td>
<td>Development of dependable systems</td>
<td></td>
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<td>Scalability to different vehicle and platform variants</td>
<td>PO 5</td>
<td></td>
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<tr>
<td>PO 3</td>
<td>Sustainable utilization of natural resources</td>
<td></td>
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<tr>
<td>Broad variety of functional domains</td>
<td>PO 6</td>
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<tr>
<td></td>
<td>Standardization of basic software functionality of automotive ECUs</td>
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<td>Support of applicable international automotive standards and technologies</td>
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</tbody>
</table>
Main working topics

- Architecture
- Methodology
- Acceptance Tests
- Application Interfaces
Main working topics

Software architectures including a complete basic software stack for ECUs – the so called AUTOSAR Basic Software – as an integration platform for hardware independent software applications.
Main working topics

Methodology

- Architecture
- Acceptance Tests
- Application Interfaces

Defines exchange formats and description templates to enable a seamless configuration process of the basic software stack and the integration of application software in ECUs. It includes even the methodology how to use this framework.
Main working topics

Specification of interfaces of typical automotive applications from all domains in terms of syntax and semantics, which should serve as a standard for application software.
Main working topics

Specification of test cases intending to validate the behavior of an AUTOSAR implementation with AUTOSAR application software components or within one vehicle network.
Topics

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AUTOSAR standardizes two software platforms – Classic and Adaptive

Common Bus Interface Specification
AUTOSAR Classic Platform is worldwide on the road

First choice for deeply embedded ECUs with high demands regarding safety and deterministic execution.

Targets small and medium sized microcontrollers.

Common Bus Interface Specification

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Software architecture of AUTOSAR Classic Platform

- Application Software Component
- Actuator Software Component
- Sensor Software Component
- AUTOSAR Software Component
- Operating System
- Services
- Communication
- Basic Software
- ECU Abstraction
- Complex Device Drivers
- Microcontroller Abstraction
- ECU-Hardware

- AUTOSAR Interface
- Standardized AUTOSAR Interface
- Standardized Interface
Basic approach

Virtual Integration

Introduction of HW Attributes

ECU Configuration
Basic approach

Virtual Integration

Independent of hardware

SW-C Descriptions

Application Layer

Virtual Functional Bus
Basic approach

Introduction of HW Attributes

Holistic view of the entire system, both software and hardware

Tools supporting development of software components

ECU Descriptions

System Constraint Description

ECU Descriptions
Basic approach

ECU Configuration

- Run-Time Environment
- Separation of system into its ECU plus common infrastructure
HW and SW applications are decoupled from each other.
Acceptance Tests for the AUTOSAR Classic Platform

Acceptance Tests at Application Level, RTE and Services

Acceptance Tests at Bus Level

Software under Test
Game changer for AUTOSAR – selected main drivers

Main drivers for new automotive software systems have been determined.

► Highly automated driving
Game changer for AUTOSAR – selected main drivers

Main drivers for new automotive software systems have been determined.

» Car-2-X applications
» Internet of Things and cloud services
Game changer for AUTOSAR – selected main drivers

Main drivers for new automotive software systems have been determined.

- Increasing data rates
Game changer for UTOSAR – selected main drivers

Main drivers for new automotive software systems have been determined.

- New processor technologies
AUTOSAR Adaptive Platform for realizing future drivers

- Supports the simple distribution of adaptive applications within Adaptive Platform instances
- Interacts with Classic Platform and non-AUTOSAR systems.
AUTOSAR runtime for adaptive applications

AUTOSAR Runtime for Adaptive Applications

AUTOSAR Adaptive Foundation

AUTOSAR Adaptive Services

(Virtual) Machine / Hardware
AUTOSAR runtime for adaptive applications – functional clusters

**AUTOSAR Runtime for Adaptive Applications (ARA)**

<table>
<thead>
<tr>
<th>Time Mgmt.</th>
<th>Execution Mgmt.</th>
<th>Software Configuration Mgmt.</th>
<th>Security Mgmt.</th>
<th>Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
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<tr>
<td>Persistence</td>
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<tr>
<td>Bootloader</td>
<td>Platform Health Mgmt.</td>
<td>Logging and Tracing</td>
<td>Hardware Acceleration</td>
<td>Communication Mgmt.</td>
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</table>

(Virtual) Machine / Hardware

ARA consists of a POSIX subset of interfaces named PSE51. Those are extended by APIs and Services defined by the functional clusters.

Services/APIs are provided via ARA to the applications.

Language specific APIs as part of ARA

Language specific APIs as part of ARA
## Classic Platform vs. Adaptive Platform

### Technical characteristics

<table>
<thead>
<tr>
<th>Classic Platform</th>
<th>Adaptive Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on OSEK</td>
<td>Based on POSIX</td>
</tr>
<tr>
<td>Execution of code directly from ROM</td>
<td>App. is loaded from persistent memory into RAM</td>
</tr>
<tr>
<td>Same address space for all applications (MPU support for safety)</td>
<td>Each application has its own (virtual) address space (MMU support)</td>
</tr>
<tr>
<td>Optimized for signal-based communication (CAN, FlexRay)</td>
<td>Service-oriented communication</td>
</tr>
<tr>
<td>Fixed task configuration</td>
<td>Support of multiple (dynamic) scheduling strategies</td>
</tr>
<tr>
<td>Specification</td>
<td>Specification and code</td>
</tr>
</tbody>
</table>
The platforms are organized by 5 AUTOSAR standards

- Acceptance Test
- Application Interfaces
- Classic Platform
- Adaptive Platform
- Foundation
Topics

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Key factors to make AUTOSAR Adaptive Platform a success

- Short development cycles
- Frontloading of validation
- Precision and quality of the standard
- Early availability of exemplary implementation
- Interoperability and increased quality
Key factors to make AUTOSAR Adaptive Platform a success

- Collaboration between other standardization bodies
- Joint development of specifications and exemplary software implementations
Joint development of AUTOSAR specifications and exemplary software implementations for the AUTOSAR Adaptive Platform

Development in AUTOSAR Work Packages

- AUTOSAR Specifications
  - Licensing for exploitation
  - validate
  - improve

- AUTOSAR Software Implementations
  - Providing for product development

› Usage by AUTOSAR partners
Cooperation with other standards

Open to connect with others
Identifying / monitoring open source projects
AUTOSAR Achievements and Outlook (1/2)

Milestones, just to name a few

- First release
- Basic SW complete
- Feature enrichment
  - Multicore support
  - Functional safety
  - Ethernet
  - ...
- Release 4.1.1
  - Timing analysis
  - Diagnostics
  - Acceptance testing
  - ...

AUTOSAR founded

AUTOSAR Achievements and Outlook (2/2)

Milestones, just to name a few

- **Release 4.2.1**
  - Large data communication via Ethernet and CAN FD
  - Integration of non-AUTOSAR systems
  - …

- **10 years of AUTOSAR**
  - 6th OC Nov 13

- **Release 4.3.0**
  - Hardware Test Management on Startup and Shutdown
  - Crypto Interface
  - V2X Support
  - Extended Buffer Access for Rapid Prototyping
  - SOME/IP Transport Protocol Decentralized Configuration

- **Release 4.3.1**
  - Quality
  - Interface Module for Ethernet and IP testing
  - Macro Encapsulation Of Library Calls
  - Error Detection and Correction for Communication

- **Release 4.4.**
  - Remote Event Communication Manager
  - Harmonization of Physcial Units for ASW and BSW Based on ASAM
  - Security Policy Manager Module
  - AUTOSAR Real Time Interface
  - RTE Implementation Plug-Ins
  - LIN-Support for LIN slave
  - Ethernet Wake on data line
  - Formal Model Query and Blueprint Derivation Mechanisms
  - Bus-Mirroring
  - Extended Serialization for Data Structures in SOME/IP with tag/length/value encoding

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AUTOSAR Platform Roadmap

Acceptance Tests
- R1.2.0
- Review of open RFCs

Adaptive Platform
- R17-03
- R17-10
- R18-03
- R18-10

Classic Platform
- R4.3.0
- R4.3.1

Foundation
- R1.1.0
- R1.2.0

Life Cycle
- development
- evolution
- maintenance

Q1/17
- new contracts
- released
- planned
- on demand
AUTOSAR Adaptive Platform Roadmap

METHODOLOGY
- Diagnostic Extract
- Manifests
- Methodology Extensions for Adaptive

EXECUTION MANAGEMENT
- Integration of Applications onto Platform
- Start and Stop of Applications
- Resource Management
- Recovery action framework
- Machine State handling
- Resource Management
- Parallel Processing by HWA
- Recovery action framework

POSIX OPERATING SYSTEM
- OS Application Interface (PSE51 & C++STL)
- Maintenance and Improvements
- Common System Model

Life Cycle
- R17-03
- R17-10
- R18-03
- R18-10

Q1/17 | Q2/17 | Q3/17 | Q4/17 | Q1/18 | Q2/18 | Q3/18 | Q4/18

✓ released | planned | on demand | development | evolution | maintenance
AUTOSAR Adaptive Platform Roadmap

**COMMUNICATION**
- DTC Management
- ISO 14229 / ISO 13400

**DIAGNOSTICS**
- Service-Disclosure and Service-based Communication
- Events, Fields and Methods
- Language-Binding: C++
- Inter-Process Communication
- Bus-Binding: SOME/IP

**Q1/17**
- R17-03

**Q2/17**
- R17-10

**Q3/17**
- **✓** released

**Q4/17**
- **✓** planned

**Q1/18**
- **✓** on demand

**Q2/18**
- **✓** released

**Q3/18**
- **✓** planned

**Q4/18**
- **✓** on demand

- **Life Cycle**
  - development
  - evolution
  - maintenance

**Q3/18**
- **✓** on demand

**Q4/18**
- **✓** on demand

**Q3/18**
- **✓** on demand

**Q4/18**
- **✓** on demand

**Q1/18**
- **✓** on demand

**Q2/18**
- **✓** on demand

**Q3/18**
- **✓** on demand

**Q4/18**
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**Q4/18**
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**Q1/18**
- **✓** on demand

**Q2/18**
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**Q3/18**
- **✓** on demand

**Q4/18**
- **✓** on demand

**Q1/18**
- **✓** on demand

**Q2/18**
- **✓** on demand

**Q3/18**
- **✓** on demand

**Q4/18**
- **✓** on demand

- **DIAGNOSTICS**
  - Diagnostic Client
  - Maintenance and Improvements
  - Vehicle API
  - Further Language-Bindings
  - LIN Support
  - Support of CAN and CAN-FD

- **COMMUNICATION**
  - Time Synchronization
  - Support of RESTful
  - Network Management Ethernet
  - Signal-based Communication
  - Support of RESTful
  - Network Management Ethernet
  - Vehicle API
  - Further Language-Bindings
  - LIN Support
  - Support of CAN and CAN-FD

- **DIAGNOSTICS**
  - Diagnostic Client
  - Maintenance and Improvements
  - Vehicle API
  - Further Language-Bindings
  - LIN Support
  - Support of CAN and CAN-FD

- **COMMUNICATION**
  - DTC Management
  - ISO 14229 / ISO 13400
  - ISO 14000 / ISO 14229 completion
  - Handling of SW Clusters

- **DIAGNOSTICS**
  - Diagnostic Client
  - Maintenance and Improvements
  - Vehicle API
  - Further Language-Bindings
  - LIN Support
  - Support of CAN and CAN-FD

- **COMMUNICATION**
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  - ISO 14229 / ISO 13400
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- **DIAGNOSTICS**
  - Diagnostic Client
  - Maintenance and Improvements
  - Vehicle API
  - Further Language-Bindings
  - LIN Support
  - Support of CAN and CAN-FD
AUTOSAR Adaptive Platform Roadmap

**LOGGING / TRACING**
- Logging and Tracing

**SAFETY**
- C++14 Coding Guideline
- E2E Communication Integrity
- Platform Health Management
- Safety concept for AP
- E2E Communication Integrity

**PERSISTENCY**
- Data Storage
- Data Storage
- Safe Data Storage
- Persistent Data Encryption
- Maintenance and Improvements
- Maintenance and Improvements
- Maintenance and Improvements
- Maintenance and Improvements
- Maintenance and Improvements

**Life Cycle**
- Development
- Evolution
- Maintenance

**Release Dates**
- Q1/17
- Q2/17
- Q3/17
- Q4/17
- Q1/18
- Q2/18
- Q3/18
- Q4/18

**Status**
- released
- planned
- on demand
Field of Applications

Automotive applications
Use-cases related to engine powered, land-based, non-railed vehicles, such vehicles intended for primary transportation purposes.

Derived application
Use-cases that are neither an Automotive Application nor in a field of use of products or service that falls into the categories of ultra-hazardous activities.

Ultra-hazardous activities
Aerospace and aviation, nuclear power, chemical and/or biological reactors, petrochemical, or military (except for military marine transportation vessels).

Original target

Extended

Excluded
How do we do that?
Evolution of AUTOSAR’s Organizational Structure

Legend:
- Core Partner
- Core Partner, Premium and Development Partner
- All partners including Associate Partners
- Subcontractor

Support Functions
- Project Management
  - Technical Management
  - Quality Management
- Specification Management
  - Change Management
  - Release Management
  - Quality Assurance
- Engineering
  - Technical Office

Executive Board
Steering Committee
Project Leader Team
Communication Team
Legal Team
Feature Teams
User Groups
Work Packages

Project Organization

Administration
- OSS Control Board
- Consensus Finding CCB
- Change Control Board (CCB)
User Group Structure

- **UG-IN**
  - India
  - Interoperability of exchange artifacts

- **UG-CN**
  - China
  - Demonstrator development
  - System design with 3 AUTOSAR ECUs
  - BSW integration, documentation and project closure planned for E2016

- **UG-NA**
  - North America
  - Common Training: OEM-Tier1 Workflows/ Security
  - Safety
  - Ethernet

- **UG-IE**
  - Improved Exploitation
  - 6 thesis on optimizing the use of AUTOSAR
  - Establishment of Adaptive Platform
Further information on AUTOSAR

For more information on AUTOSAR:

- Working results
- User Experiences
- Exploitation

You are welcome to have a look at AUTOSAR’s publications available at the AUTOSAR website www.autosar.org.
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